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THE PHARYNGEAL TEETH OF FISHES.

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(Continued from vol. xv. p. 456.)

CYPRININÆ. THE CARPS.

In these, the most numerous subfamily of the *Cyprinidæ*, we have a totally different formation of the pharyngeal teeth and provision of teeth in the buccal cavity to that in the families of fishes already dealt with. The absence of any teeth on the gill-rakers and first four branchial arches is marked, as is also that of the upper pharyngeal teeth. The lower pharyngeal teeth, instead of being on two more or less elongated plates on the floor of the gullet covered with a large number of small teeth, consist each side of one, two, or three series of molariform or unciform (*i.e.* hooked) or cuneiform (*i.e.* wedge-shaped) teeth.

Day, when writing on Indian fishes, describes some of the long tapering wedge-shaped teeth as *plough-shaped*, evidently having in his mind's eye the shape of the Indian ploughshare, which it resembles, and his definition of this shape will be adhered to where necessary in the following descriptions. The lower pharyngeal teeth are deciduous, and capable of being reproduced, there being in the mucous membrane surrounding these teeth a number of embryo teeth evidently intended to take the place of the larger ones in use as they fall off. Many of these spare teeth are shown in the illustrations. These lower pharyngeal teeth in the masticating process to which this family submits its food bite against a hard, horny, callous pad that is attached to the mucous lining of the upper part of the pharynx, and which is strengthened and supported by a concavity of the basi-occipital bone, very much marked in some species, less so

in others. This pad is firmly attached during life, as it takes the thrust of the lower pharyngeal teeth in chewing, but after death it is easily detached, leaving the lining membrane of the mouth seemingly intact. The pad varies very much in size, thickness, and shape in the different species, in some being a fairly solid lump, as in *Cyprinus carpio*; in others, a thin but hard striated cartilage, as in *Cirrhina mirgala*.

CYPRINUS CARPIO. The Carp. Fig. I., 1.

This fish has a number of soft gill-rakers that fit into each

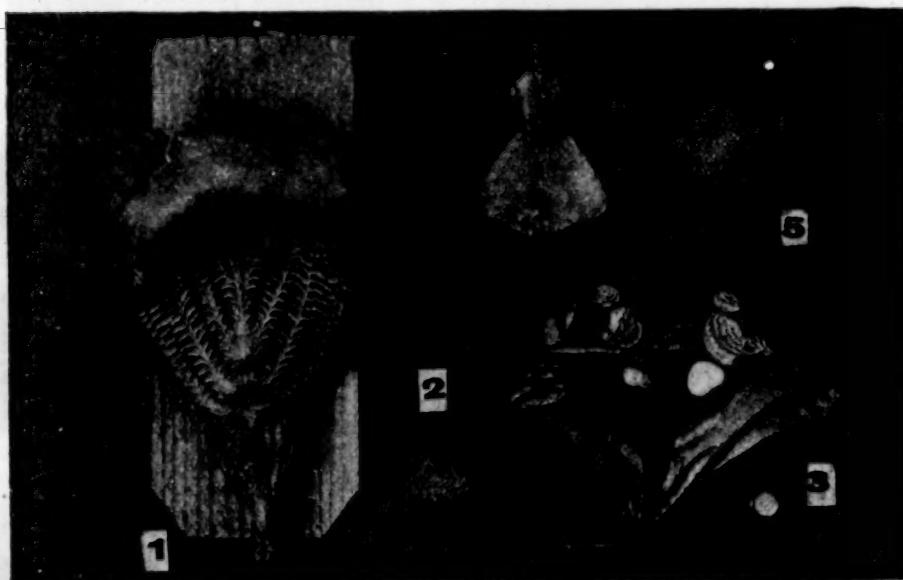


FIG. I.

1. *Cyprinus carpio*; gill-rakers. 2. Callous pad of the same fish. 3. Pharyngeal teeth of another *C. carpio*, and spare tooth. 4. Part of base of skull. 5. Callous pad that fits on same. Food passes through to the teeth in the direction away from the reader.

other from alternate sides and form a very complete filter; in general appearance each gill-arch looks like a frond of a fern. There are eighteen gill-rakers on the first cerato-hypobranchial arch, with eight on the epibranchial; the inner sides look at first sight as if denticulated, but this is due to a number of soft papillæ. The lower pharyngeal teeth are far back, and can with difficulty be seen when looking into the gullet, but can readily be felt by inserting a finger. The teeth are molariform,



arranged in a triple series. The illustration (Fig. I.) shows a gullet on the left; at the right-hand lower corner of the gullet is the callous pad belonging to this fish. On the right of the illustration is shown the lower pharyngeal teeth of another and larger fish. The molariform dentition is very clear; at the lower right-hand corner is a spare tooth found in the membranes surrounding the teeth. The upper right-hand figure (No. 5) is the callous pad against which the teeth bite, its ventral aspect, and on its left (No. 4) is shown part of the basi-occipital bone, widened out and curved, on which this pad fits. The upper part

CYPRININÆ.

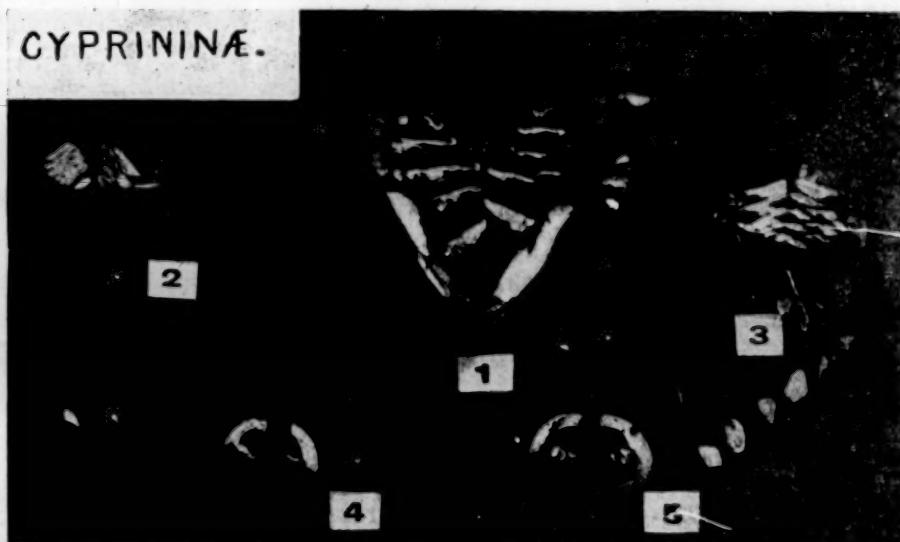


FIG. II.

1. *Leuciscus cephalus*; on left part base of skull, on right its callous pad. 2. *Catla buchanani*; with pad and spare teeth below. 3. *Labeo rohita*; pad above, spare teeth below. 4. *Carassius auratus*; pad, and one spare tooth. 5. Hybrid *C. auratus* × *Cyprinus carpio*; and pad.

of the pharynx is covered with a smooth, thick, mucous membrane, said to be, by gastronomic epicures, appreciated when properly stewed, and spoken of by them as the "carp's tongue." The fifth branchial arch that carries the pharyngeal teeth is curved, the concave arc being towards the front; it is very strong, channel V-shape in its middle portion, and divided up by bony diaphragms into a series of cells, combining strength with lightness. The food of the Carp is principally vegetable, but they occasionally eat worms and insects.

CARASSIUS AURATUS. The Goldfish.

The pharyngeal teeth of this fish are in a single series and of a wedge-shape, or perhaps would be more accurately described as like the cutting edge of an axe. Fig. II., 4, shows a set viewed from the back. Its pad and a spare tooth are also shown.

HYBRID CYPRINUS CARPIO × CARASSIUS AURATUS.

This cross between a Carp and a Goldfish shows in the specimen examined that the dentition followed that of the *Carassius* parent (Fig. II., 5) in being in a single row, and of the axe-shape. It is of interest here to note that in this case the barbel of the Carp was wanting, as also the golden colour of the Goldfish, the colour of the hybrid being dark, as seen in some Goldfishes.

CATLA BUCHANANI. An Indian Carp. Fig. II., 2.

The general aspect of the gullet of this fish is more like that of a Clupeoid than a Cyprinoid fish, owing to the numerous long, thin, horny gill-rakers. On the first cerato-hypobranchial there are 179, and 74 on the epibranchial. The closeness and fine quality of these will be recognized when it is noted that in one inch of length at the centre of the arch there are 60 gill-rakers. The length of the gill-rakers at the angle is about the same as that of the gill lamina below them. The gill-rakers on the outer side of the first arch all slope forward. Similar thin gill-rakers, but standing straight up, line the inner and outer edges of the other arches; their tops, however, curve towards each other, those on the outer edges towards those on the opposite inner edges, forming a vault over the gill-slit, but by their length adding to the filtering area. At the back of the buccal cavity there is a hiatus in this gill-slit vaulting; there the gill-rakers do not bend towards each other, but leave three pronounced elliptical openings parallel to each other on each side of the mouth. The pharyngeal teeth are plough-shaped. Two spare teeth were found, and many of the functioning teeth were loose. The illustration shows a specimen with pad and loose teeth below it. For the size of the fish the lower pharyngeal bones are small, so consequently is the opening into the teeth. The upper lining of the gullet has a thick mucous pad with

marked corrugations that fit into the depressions caused by the upstanding gill-rakers.

LABEO ROHITA. The "Rohu" of the Indian bazaars. Fig. II., 3.

The thin, horny, short gill-rakers are very numerous, set closely together, and covered with a mucous secretion that obliterates them individually, and that gives to the gill-arches the appearance of having a fringed band on each side. The pharyngeal teeth (see illustration) are in three series, plough-shaped, and work against a projection of the basi-occipital that is covered with a thick, hard skin, which is striated. The arrangement of the teeth is such that they present a flat surface. The worn surface of the functioning teeth shows well in the illustration; two of them were found to be loose. Six extra teeth were found embedded in the tissues surrounding the working teeth. The lower pharyngeal bones have holes through them, and no diaphragms as in the Carp.

LABIO NILOTICUS. A Nile fish.

Has thirty-two straight, very fine, horny gill-rakers on the first cerato-hypobranchial arch, with twelve on the epibranchial. The inner and outer surfaces of the other gill-arches are set with similar gill-rakers that interfold, forming a complete filter. The pharyngeal teeth are conically pointed.

BARBUS BYNNII. A Nile fish.

Has fourteen horny, slightly curved gill-rakers on the first cerato-hypobranchial arch, with three on the epibranchial. The other arches covered with soft gill-rakers that fit closely together and make a complete filter. No callous pad was observed, the teeth working against the lining membrane of the back of the gullet.

BARBUS VULGARIS. The Barbel. Fig. III.

There are seven short, stout, horny gill-rakers on the first cerato-hypobranchial arch, with three on its epibranchial. The longest one, at the angle, is one-third the depth of the gill lamina below it. The gill-rakers on the other arches are much more numerous, and the general appearance is like that of a Carp's gullet (see ante), but each one is covered with papillæ,

and with a knob-like papilla at its extremity. In the direction of their length these gill-rakers have an S-like curve. They form a very close filter. The lining of the top of the gullet is a thick mucous membrane, covered with papillæ in the centre, and at the sides has longitudinal corrugations, where it is pressed down on to the gill-slits between the arches. The pharyngeal teeth are in three rows, 5-3-2 and 2-3-5, slightly hooked at the ends. There is no callous pad, the teeth biting against the thick membrane mentioned above.

LEUCISCUS CEPHALUS. The Chub. Fig. II., 1.

Has seven small horny gill-rakers on the first cerato-hypo-branchial, with one on the epibranchial. The other arches are furnished with similar gill-rakers, but placed rather far apart and interlocking. They do not form such a good filter as in the fishes already described. The pharyngeal teeth (Fig. II., 1) are in two rows, mostly uncinate (*i.e.* hooked) at the point, and bite against a horny pad that fits against a portion of the basi-occiput shaped to receive it. The lower pharyngeal bones are strong, but lightened by their hollow shape stiffened with cross diaphragms. Food is mostly vegetable, but this fish devours insects, and can be caught with worm-bait.

LEUCISCUS ERYTHROPTHALMUS. The Rudd. Fig. III.

Has seven very short horny gill-rakers, about one-fourth of the depth of the gill lamina below it. There are three on the epibranchial. The other arches have short stumpy gill-rakers that form, however, a close filter. The pharyngeal teeth are in a double row, 5-2 and 2-5, with a slight hook at their ends. As many as eight loose teeth were found, some embedded in the tissues round the teeth, and others occupying places where they would eventually become solidly attached. A thin, hard pad, shaped like the "spade" in playing-cards, was on the under side of the skull for these teeth to bite against.

LEUCISCUS RUTILUS. The Roach.

The pharyngeal teeth of this fish are in a single row each side, and slightly curved at the point; they bite against a horny callous pad.

LEUCISCUS DOBULA. The Dace. Fig. III.

Has five short, thin, horny gill-rakers on the cerato-hypo of the first branchial arch, with two on its epibranchial. The longest one near the angle is half the depth of the gill lamina below it. The other arches are furnished with but comparatively few gill-rakers set at a distance apart. The pharyngeal teeth are slightly hooked at the extremity, and are set in a double row, 5-2 and 2-5. They bite against a callous pad.

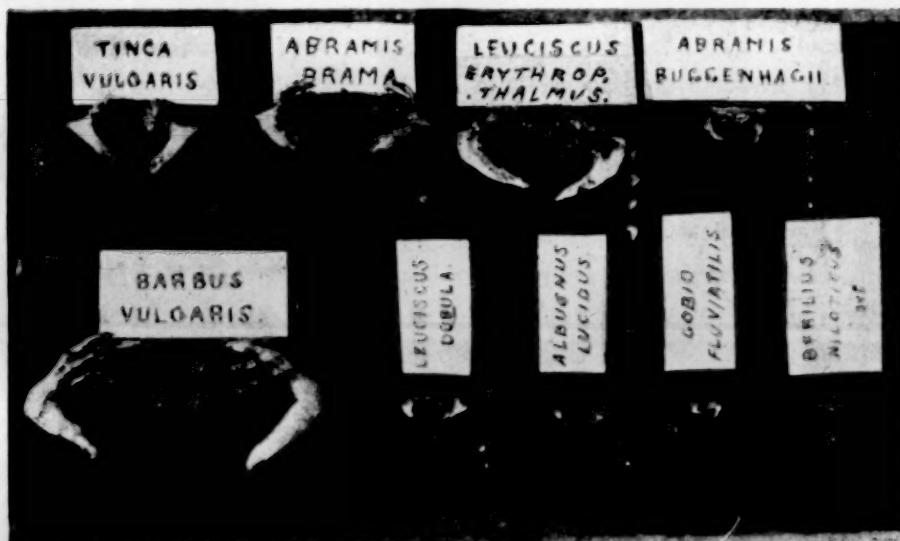


FIG. III.

TINCA VULGARIS. The Tench. Fig. III.

Has nine short, horny gill-rakers, the longest a little less than half the depth of the gill lamina below it; they diminish in size as they get away from the angle—these are on the first cerato-hypobranchial arch. There are three on the epibranchial. There are similar gill-rakers on the other arches, and the whole forms a very efficient filter apparatus. The pharyngeal teeth are in a single row of wedge-shaped teeth, with a slight hook at their ends. The upper back part of the gullet has a thick mucous lining, and a callous pad for the teeth to bite against. Four loose extra teeth were obtained in the specimen examined. and figured.

ABRAMIS BRAMA. The Fresh-water Bream. Fig. III.

Has nineteen horny gill-rakers on the first branchial arch in its hypo-cerato portion, short and broad at their base, terminating, however, in a fine hair-like point; the last two gill-rakers are rudimentary. The largest is only one-third the depth of the gill lamina's depth below it. There are three small gill-rakers on the first epibranchial. On the other arches there are numerous gill-rakers that fit alternately and make a close filter; those on the inner sides of the first, second, and third arches resemble little fleshy lumps, terminating in a fine hair at the apex. The teeth are in a single row, five each side, and slightly curved at the extremity; they bite against a small callous pad of an elongated oval shape. The whole of the upper part of the gullet is covered by a thick mucous membrane.

ABRAMIS BUGGENHAGII. A hybrid. Fig. III.

This is a cross between the *Abramis brama* and the *Leuciscus rutilus*. Its pharyngeal teeth are slightly curved at the extremity; as, however, this is also the case with both its parents, there is no favouring one or the other side in this, as was noted in the cross between the Carp and the Goldfish mentioned before.

GOBIO FLUVIATILIS. The Gudgeon. Fig. III.

Has minute gill-rakers on all the arches. The teeth are curved at the extremity; they bite against a callous pad, and are in two rows, 4-2 and 2-4.

BARILIUS NILOTICUS. A Nile fish. Fig. III.

The teeth are curved at the point.

ALBURNUS LUCIDUS. The Bleak. Fig. III.

Has eight long, thin, horny gill-rakers on the first hypo-cerato portion of the first branchial arch, with two on the epibranchial; the other arches have very small but numerous gill-rakers. The longest ones on the first arch are about four-fifths of the depth of the gill lamina below it. The teeth are curved at the extremity to the extent of being slightly hooked. They are in a double row, 5-2 and 2-5. No particularly hard callous pad was noticed for the teeth to bite against.

CIRRHINA MIRGALA. An Indian fish.

Has numerous short, horny gill-rakers on the first branchial arch ; there are some fifty-six on its hypo-cerato portion, and twelve on the epi-portion. The longest is only about one-sixth of the depth of the gill lamina below it. Similar gill-rakers are on the inside of the first branchial arch and both sides of the other arches. The upper surfaces of the arches themselves are flattened, and the membrane over them is much corrugated. The mucous membrane at the top of the mouth is covered with papillæ. The pharyngeal teeth bite against a thin cartilage that is striated, and that covers the lower part of the basi-occipital bone, where it widens out into a broad surface to afford a base for this cartilage. This base protrudes backward, but is widened out horizontally into a broad leaf-shaped mass, thus materially differing from the similar prolongation in a Carp (*Cyprinus carpio*), for instance, where the projection takes a vertical form. The pharyngeal teeth are in three rows, 5-4-2 and 2-4-5 ; they grow upon stalks, and widen out at their tops, providing a flat chewing surface. Five spare teeth were found in the mucous membrane, and two clinging to the base of the teeth. The pharyngeal bones are not channelled and stiffened with bony diaphragms, as in so many of the other *Cyprininae* (see illustration of Carp), but are solid and made lighter by a large triangular opening in the bone, where it is widened out to afford a seat for the teeth, which are supported on a base of honeycombed bone stretching across the open triangular space. These pharyngeal bones, the fifth branchial arch, are fairly straight up and down in this fish, and have not that concave set as seen from the front, as is the case with many others of the *Cyprininae* subfamily.

AN OBSERVATIONAL DIARY ON THE DOMESTIC
HABITS OF THE RED-THROATED DIVER (*CO-*
LYMBUS SEPTENTRIONALIS).

BY EDMUND SELOUS.

(Concluded from p. 180.)

July 27th.—*In situ* at 10.50 a.m., and see, at first, only one chick by itself, some way out from the bay. It swims up the loch, and I then see the other chick at the farther end. After a little the mother bird, as I take her to be, comes out of the bay and joins the chick, and shortly afterwards the male (certainly the larger bird) flies in with a fish, which he gives to the chick—the mother's chick as I take it to be—the latter taking it from the bill. Both parents now stay about, for a little, on this part of the loch, they being either with the one or the other, or a little apart, and whilst the male now several times utters his deep guttural quack, as one may call it, the female responds with a hoarse, strained note which I have not heard before. Nothing comes of this, however, and, at about 11.40, the female—that is to say, the smaller bird—flies away.

All this is very revolutionary. In the first place, the mother's chick—as I have hitherto considered it—swimming out into the body of the loch whilst the mother is in the bay is unusual, and now the male, instead of going, with his fish, to his own chick, who remains alone at the upper end of the loch, feeds the mother's chick, and remains with this one after the mother has flown away; for it is now within a few minutes of 1, and he has not left it, keeping with it on the lower part of the loch, as the mother used to before she moved to the bay.

Some time between 1.30 and 2 p.m. the female returns, and probably feeds this same chick again, as the three birds are all together when I see her at what can only be a few moments after her arrival, though, not feeling very well, I miss both this and the other. It is the female, too, I think, who, a little while afterwards, flies off again, leaving the male with the same chick, and, after awhile, these two swim into the bay. A constant wind has driven me into my old place, which is more sheltered, and

from here I cannot see them. At 3.15 p.m., however, the parent flies out, up the loch, and away, and, walking to the bay, I see the chick there alone. All this time—since 10.50 a.m., when I arrived—the second chick has been by itself at the far end of the loch.

4.10.—Parent and chick appear in that part of the bay which I am able to see. From the appearance of the former I take him to be the larger one—the male—and he must have flown in behind the rise, so that I did not see him. He now swims out into the loch, and, again, back into the bay, still accompanied by the chick. The whole thing appears most strange to me, for all this time the other chick remains invisible at his end of the loch, and he has not been fed for five and a half hours, as a minimum.

About 5.15 the male and chick come out of the bay, and swim up the loch to the other end of it. No second chick, however, comes out to join them, although the parent bird passes along the shore where it has hitherto almost always been, several times, seeming to be looking for it, and at 5.20 the female flies in with a sand-eel, and gives it to the other chick—the one she fed before—the only one that has been fed since I came at 10.50 a.m. The male, shortly after, swims into the bay, and is soon followed by the female and chick, and I then hear from the bay the curious, wild, skirling note which these birds utter when together, and not domestically occupied. In some ten minutes or so they swim out, and, about 5.45, the male—as I think it is—flies away. But no trace of the second chick all this time—it is now past 6—and I fear something has happened to it. In order to verify this, I, a little later, begin to walk round the loch, and as I get to the point round which it and one of the parent birds have used constantly to disappear, all of a sudden it runs from a yard or two off from the brink (five feet, at least, I should say) and takes the water. It ran quickly, with its body craned forward at an angle. What the angle was I cannot quite say, but certainly it did not go upright, like a Penguin. Thus, then, this one chick, as far as I have been able to observe, has not been fed between 10.50 a.m. and 7 p.m.—for it is that now, as I leave—and, to judge by its not appearing on the water, it has been lying the greater part of that time on the bank. Also,

since yesterday, at any rate, the male bird's habit of sitting at a certain spot by the water's edge, in company with one of the two chicks, has been discontinued. This chick, which has to-day sat for eight hours unfed, is noticeably smaller than the other one. The question arises, Is it sickly and going to die, and has the parent transferred its attentions to the healthier one, because it divines this?

Whilst walking round the loch, to-day, I came upon the nest of these Divers. It is some halfway along it, and instead of being just on the edge of the water—as is the case with the other one I found—it is some four or five feet away from it on the top of a fairly high hillock, at the foot of which is the loch. These facts seem remarkable, and explain my not having seen the nest before, since I only looked close along the water's edge. This nest is not a mound, as was the other, but a mere shallow depression amidst the grass, and in this some moss and heather had been laid. The height of the bank where the birds, whilst incubating, had ascended, to climb up the hill, was some six or eight inches, and the exact place was instantly seen, since it had been worn into a sort of sloping slide, very much like those made by Otters where they enter and leave the water, which I have often seen.

July 28th.—*In situ* about 12.40 p.m., and just see one of the birds, for a moment, on the water, before it disappears. After awhile I see one of the chicks at the upper end of the loch, and at 12.50 the male (I think) swims out of the bay with a long eel-like fish, as all the others have been—a sand-eel, I suppose—in his bill. He dives up the loch, feeds the chick with it, and then, as it were, brings the latter down the length of the loch into the bay. The chick, I think, would not have come of itself, for it is a very windy, though a very fine day, and the loch is all in waves. But which chick is this? Is it the one which used always to stay at the upper end of the loch—in the little basin there—and rest with one of the parents behind the point, or the one which used to stay as constantly at the other end of the water? Whichever it was, I saw only one chick, at intervals, during the day. At about 7 p.m. I saw it for the last time, and I then, before leaving, walked round the little basin at the upper end, expecting to see the other—the one that has always kept

there—run into the water at the same place that it did yesterday, but in this I was disappointed, and I now fear the worst.

July 30th.—*In situ* at 11.45 a.m., and find the female—that is to say, the smaller Diver—with one of the chicks, the other having now, as it would seem, permanently disappeared. The two are in the bay, or just at the entrance of it, as usual, and, at about 12, the male flies in only just over my head, and, coming down by them, gives the chick a fish—taken by it from the bill—which does not this time look like a sand-eel, and which, as far as I can make out, in a good view through the glasses, has no head. The three then float about together, but a little sundered, the male sometimes uttering a few deep quacks, and the female that other strained note I have spoken of—a sort of “quew-oo-oo,” plaintive and wild in its character. She bends her head slightly forward, to make it, and, all at once, this action becomes more emphatic, and the note louder and longer. Her head and neck are now stretched along the water, her body almost submerged in it, and, in this manner, she advances, in a series of little plunges, towards the male, who comes to meet her, uttering now the same cry, and also his deep guttural quack. It is a sudden outburst of excitement between the two, either of a sexual or social character, and has a strange, wild appearance, infinitely delighting to see—to see, too, at very close quarters, amidst full sunlight, on the darkly sparkling waters of this little lonely loch. Each time, in making the cry, the birds raised their heads from the surface of the water, arching the neck, somewhat, as they attained their height, and now these lovely necks were no longer smooth, as before, but creased into long rigid wrinkles, as though the skin covered several pipes—all was now tense, strained, and rigid. Thus they advanced and met each other, and so continued, for a little, floating in one another’s proximity, then gradually quieted down—a strange, wild, interesting scene. To the wild feelings of the birds’, something deep down in my own human organism—stifled and overlaid, but felt now, again, with strange yearnings—seems to correspond. This may be real or imagined, but how predominant is personal proclivity! I would sooner see a thing like this than a dozen coronations, with processions and appurtenances, though sitting in a good front seat all the while. And

then imagine old Pepys' feelings, had such an exchange been proposed to him !

The female, after this, swam halfway up the loch by herself, and then, a little after 12.30, flew off it, leaving the male and one chick swimming together in the bay. About 3.5 the female returns, but unfortunately, though I was looking at the male and chick, a moment or two before, I miss both her arrival and probable feeding of the latter, only seeing her just after this.

At 3.20 the male flies away.

44.8.—Male returns, his wings making a sonorous swish as he slants down, holding them raised and steadfast. He carries a fish which looks like a small herring—about twice the size of a Cornish pilchard or "sardine"—and, swimming to the chick, the latter takes it from his bill.

I have now watched the two birds for half an hour, at a fair distance, with and without the glasses, in sun and shade, and can say that the neck—using the word inclusively—is a most conspicuous feature, without any quality of "concealing coloration" that I can discover, and that the red, or deep chestnut-red mark, on the throat, is so far from this that it looks as though the bird's throat were cut, and streaming, or rather suffused, with blood. It is not, indeed, blood-colour, but sufficiently near it to suggest this, and almost as lurid. The bird that I take to be the male is the more ornate, as well as the larger of the two. The white of his throat, under the chestnut, is more brilliant and strikingly contrasted with the latter, and the chestnut itself deeper, though, perhaps for this reason, not of quite so bright a tint. It seems, however, to be a step or two farther on the road of its natural development.

The notes of this date—*viz.* July 30th—appear to be the last that I made on this pair of Divers. I can find in them no entry of having found one of the chicks lying dead on the bank of the loch, in the neighbourhood of the place where it (assuming it to have been the same one) had been accustomed to sit; yet it is clearly impressed upon my memory that I did so find it. In fact, I remember it so distinctly, with the feeling of regret which the discovery produced, as also that there were no marks of violence on the body, but only of emaciation or meagreness, that

I can only account for the omission by supposing that I meant to put it down, on my return to the cottage, but omitted to do so, and that my vivid remembrance of the incident made me suppose that I had. It would seem, then, as though one of the chicks had never been healthy and robust, like the other, and that it showed this deficiency by persistently sitting on the bank, instead of swimming in the loch with one or both of its parents. One of these—the male, as I believe—fed it, under these conditions, for a considerable time, but, at last, appeared to divine that it was doomed, and then neglected it, and helped feed the other. The fact of this neglect, or transference of attention, at any rate, whilst the chick was still living, is, I think, established by my entries, and it is an interesting fact, for useless attention to any sickly offspring is in nature a waste of affection, and the species should gain by the transference of such affection to where it would not be so wasted. Thus natural selection should tend to discourage parental devotion beyond a certain point. But the fact of one of these two chicks having been weakly may make my observations of less value as a presentment of the ordinary domestic habits of these birds.

July 31st.—I had been thinking, hitherto, that these young Divers stayed on their native loch till able to fly, and then left it with their parents, but now I find that, in some instances, at any rate, while still quite young and in the fluff stage—presumably, therefore, unable to fly—they can get from one loch to another. In my entry of the 24th inst., I note finding two chicks on a quite small peaty loch, and a day or two afterwards, whether entered or not, I found, as I thought, yet another pair in a loch of the same kind, quite near it, which, before, had seemed empty. It seems likely, at any rate, that these were the same pair that were, at first, in the neighbouring loch, but have since, for some reason, migrated from it.

To-day I came to this last-mentioned loch, late in the afternoon, and, about 6, one of the parent birds flew in with a fish, and fed one of the chicks, both of them being together on the water. I propose now to watch this family for the next two days—Monday and Tuesday—which will be all I can do, since I must leave on Wednesday morning early. My object will be to see if what I observe accords with my observations on the birds I have hitherto been watching.

August 1st.—*In situ* at the small loch, mentioned in last entry, by 10.40 a.m., and find the two young Divers there alone. I waited the livelong day—a particularly fine day, but unfortunately equally so for the midges—and it was only at 6.7 p.m. that one of the parents flew in with, presumably, a fish, for the two young ones hurried up, and the dam made as though withholding it for a little before giving it to one of them—but I could not actually see either the fish or the delivery. From his size and gamey appearance this parent looked like the male. A few minutes after feeding the chick he flew off again. Thus for about seven and a half hours, as a minimum, these young Divers have been left alone, and unfed, by their parents. Somewhere about the middle of this long period they dived several times in a brisk and active manner, but, supposing them capable of catching fish for themselves, this mere pool amidst the surrounding turf, with spongy banks and a muddy or peaty bottom, is not likely to contain any. If fed entirely by the parents, then when, and how often, are they? Perhaps each morning and evening, for the parent has come in to-day, at the same time, within ten minutes, as yesterday.

6.37.—Iird in again, and there is just the same scene, but the distance is too great for me to make out the details, and the splash made by the bird, as it came down on the water, hid everything for a little. Evidently he brought in a fish, and gave it, presumably, to the other chick. His whole air and manner was as coming with a special purpose, and he was off again almost, if not quite, within the minute.

In again about a minute before 7, and off at 7. He came down with great impetus, so that he skimmed almost the length of the little pool, right to the shore. This time I saw the fish plainly—a sand-eel, I think—and one of the chicks, scurrying forward before the other, received it from the bill of the parent. As for the sex of the latter, however, all I can say is that it is a fine large bird, and looks like the male. I have not the other, now, to compare him with. These chicks are older than the ones I have been watching. How much older I do not know; they seem still woolly, and have much the same general appearance, but when they stand up in the water, and flap their wings, the breast at once strikes one, for it is on the way to being white.

It is, perhaps, in relation to their more advanced age that the system of feeding them seems different to that employed with the ones I have been watching.

August 2nd.—Rose at 3 a.m., in order to get to the last-mentioned pair of young Divers in the quite early morning. It was then not light, nor did it become so till much later than I had expected here. I could have found my way, however, but for a heavy mist, which obliged me to stop and wait a long time, so that I was only *in situ* at a few minutes past 6. At 6.40 the parent bird flew in with a large fish, which he gave to the chick first up. Then, for a little, he swam about in a somewhat *affairé* or conscious manner, and the chicks followed excitedly, putting their heads down on the water, and ploughing it, thus, in swift little rushes. At 6.48 the parent flies off, and the next visit is at just a minute before 7. No doubt a fish was brought and given, as before—at least, I suppose so—but this time I see nothing, as all three birds get close under the bank nearest me, and are thus quite hidden. After they come out I notice the dam several times lower its head to just above the water, the neck stretched out, and in this attitude swim several times excitedly up and down before the chicks, going but a little way, each time, and whilst he does this he utters a short double note which I find myself unable to transcribe. The exit is at 7.12.

I stayed till 8, and then, supposing that the morning visits had come to an end, having probably commenced much earlier, I walked to the pool, and, whilst standing on its margin, the dam came whizzing just over my head, and came down on the water but a few yards away from me. Whether it had dropped or swallowed it, in alarm, upon seeing me, I do not know, but it had no fish in its bill after pitching, and the chicks were left unfed when it, shortly afterwards, flew off in affright. This was an unfortunate incident, for when I returned in the evening, hoping to see the feeding renewed, I found only one chick on the pool, and, though I waited till 7, the parent bird did not come in. It seems as though the one chick had left the pool—probably under the auspices of the parent, in consequence of the fright given to the latter. I have no doubt that, otherwise, the feeding would have gone on as usual, but the parent bird may now have feared to return, or may have been attending

to the other chick, somewhere else. But this explanation is hardly satisfactory, for, why then with such ample time, should both chicks have not been removed? These small pools in the peat or turf are so open, and the young chicks so unaccustomed to hide themselves, after the manner of Moorhens, when frightened, that, if not seen before long, their absence from the pool may be assumed. Fear would only be shown by their keeping as far off as the size of the pool allowed. One could not well miss them in such a place for long.

My reason for going to the pool was to see if there was a nest upon its banks, and contrary to my expectations, for I had not before seen any birds here, I found not one merely, but two unmistakable ones, whether this or last year's I cannot say, but the moss that had been laid down, and once, no doubt, formed a thin layer, had now become scanty wet tufts, distributed sparsely, like the kinks of a Hottentot's hair. Both these nests were very near the edge of the water; one was on a little turf-y projection of the bank—almost an island—and had the peculiarity of there being two well-marked slides, from it to the water upon either side of the peninsula, each of which, from their appearance, must have been equally made use of by the birds. It would have been interesting to see whether the two were used indifferently, either in leaving or getting on to the nest, or whether the bird always ascended by one and came off by the other. Owing to the tendency of constantly repeated actions to become uniform, and pass into a sort of routine—as with ourselves—I have little doubt, myself, that this latter was the case. The two nests were only a few paces apart. I could not, however, though I walked several times round the pool, find anything like a depression where the old bird had sat with the chicks, and so, as these places are almost, if not quite, as conspicuous as the nests themselves, I feel sure that there was none.

It would seem, *prima facie*, that one or other of these nests had been the birthplace of the pair of chicks now on this pool; yet the fact remains that two young birds are gone from the pool where I most certainly saw them—it being a very distinctive one, with peculiar and unmistakable features—whilst two, that I had not noticed before, on another one (this, namely) so near to it that, had they been there, I could hardly have

helped seeing them, were upon this other one *pari passu* with such disappearance; and, further, one of these two has now gone, again, since the morning. It appears, then, as if these young Divers, before they can fly, and whilst still fluffy, are accustomed to get from loch to loch, or at any rate, from small pool to pool, with or without the guidance of the parents. It is certain, too, from the one I saw do so, that they can run both quickly and easily, but how far they may, or are accustomed thus to travel—whether, for instance, to the sea—I do not know. It would seem, too, from the nest of the pair I watched, being some little way from the water, and on the top of a hillock, that the grown bird, too, can progress upon the land without any great difficulty, but what is the fashion of such progression I do not know.

Before leaving, this evening, I saw one of these Divers come down upon a rather large loch (as lochs go here, where the largest is but a mile long), and, having struck the water, it footed it, for a little, towards another one—its mate, doubtless—maintaining, with the help of its wings, that upright Penguin-like attitude which I have described in the pair watched by me.

The Red-throated Diver is known here amongst the people as the "Rain-Goose," as was told me by an old woman of over eighty, who was trudging briskly, though shakily, along the road. This is because they are supposed to foretell rain, the cry uttered on such occasions being interpreted as "warse weet! warse weet!" ("worse wet! worse wet!")

NEW BRITISH OLIGOCHÆTS.

BY THE REV. HILDERIC FRIEND, F.R.M.S.

At the end of 1911 I prepared a "List of Native Oligochæts," so far as they were then known,* and found that they numbered almost exactly two hundred species. In round numbers we have up till the present recorded forty species of *Lumbricidae*, eighty *Enchytraeidæ*, thirty *Tubificidæ*, nearly thirty *Naididæ*, and about twenty species belonging to four other families. Already several new worms have been discovered, and in the following pages some of these will be placed on record. In one or two instances the species have been noted by previous observers, but have been relegated to a position among uncertain species, or assigned to a genus or species to which they did not belong.

1. *Sænuris lineata*, Grube (*Lumbricus lineatus*, Müller), has been the despair of helminthologists. Beddard, Michaelsen, Vaillant, and others have all tried their hand at placing it, but never having seen the living creature they have only added to the confusion. We have two doubtful records for this worm, but they both relate to that period in the study of Oligochæts when characters were uncertain and definitions were vague. Dr. Johnston records it (' Catalogue of Worms,' p. 66) for Ferne Isles, Northumberland, while it is also mentioned as having been found in Plymouth. Beddard alludes to it in an account of *Clitellio*, and Michaelsen at one time placed it under *Pachydrilus*, and at another under *Tubifex*.

I have had the good fortune to find the worm on the north bank of the Tees near Middlesborough, and, although the month of February does not seem to be the right period of the year for finding it sexually mature, I have been able to determine its position, and make some additions to our knowledge of its structure. For the present I propose to retain the name *Sænuris lineata*, Grube, because neither *Clitellio* nor *Tubifex*, *Lumbricus*

* 'The Naturalist,' pp. 76-81, March, 1912.

nor *Pachydrilus*, is correct. While the worm is an undoubted Tubificid, it is the only species yet discovered in Britain which has setæ like *Pachydrilus*. In this respect, therefore, it is a link between the red-blooded Enchytræids and the Tubificids. *Pachydrilus lineatus*, which is entirely distinct from *Sænuris lineata*, will be dealt with later. My notes show: Length about 20 mm.; segments 65; *Tubifex*-like in character, coiling up, and not swimming or crawling like *Pachydrilus*. Head and tail pale, body in the middle ruddy brown, owing to blood-vessels (red) and chloragogen cells (brown). Absolutely no capilliform setæ, and no forked setæ, but all (2-4) of the *Pachydrilus* type. Hearts, as in *Clitellio*, in 8th and 9th segments. Nephridia in $\frac{7}{8}$ and $\frac{8}{8}$, with glandular cells, clear, as in *Limnodrilus*; also in segment 12 and later. Chloragogen cells begin in 6; no strong pharynx as in Enchytræids, but cephalization exactly as in Tubificids. Pores on segment 11 without ventral setæ. Brain convex in front, incised behind. No girdle, no clearly defined ova; and, as the specimens were not adult, certain important organs could not be studied. Possibly the testes occupy segments 9-13. Some problematical glands were seen in segments 4-5, such as are not found in any other known Tubificid or Enchytræid.

2. *ILYODRILUS MEGANYMPHUS*, Friend.—My recent researches show that the Tubificids have to be revised. Authors have hitherto confused the issues by generalizing on too slender a knowledge. It is certain that the *Tubificidæ* of Great Britain are much more numerous than has generally been supposed. While Eisen, Stole, and others have written much about *Ilyodrilus*, the differences between this genus and the true *Tubifex* have not yet been clearly defined. For the present I take *Tubifex* to have three different kinds of setæ, while *Ilyodrilus* has but two, viz. capilliform and forked. Pectinate setæ, which are said to be present in *Tubifex*, are wanting in *Ilyodrilus*. If ultimately it is found that the length of the duct is a truer genus-character, we shall have to put some species of *Ilyodrilus* under *Tubifex*.

The species now recorded was found for the first time in a little runnel which flows through the Alexandra Park at Hastings. The description will duly appear, with that of other new species,

elsewhere. I turn from the *Tubificidae* to record certain Enchytræids which are either new to England, Britain, or science.

3. **MARIONINA SEMIFUSCA**, Clap., was first described from the Hebrides. It was afterwards found in Scotland and Ireland, but until the present year its occurrence in England had never been noted. I have, however, recently received some material from Purfleet, through the courtesy of Mr. C. S. Todd, and amongst other interesting species this occurs. It is straw-coloured, about 10 mm. in length, with 4–5 setæ in front, and usually 3 (rarely 2 or 4) behind. The brain, as is most usual in this group, is incised posteriorly, the funnels of the sperm duct are three to four times longer than broad, and there are large pores at the extremity of the duct. This same species, or one closely resembling it, was also found on the banks of the Gelt at Gilsland, Feb. 12th, 1912. The species of *Marionina* and *Pachydrilus* (= *Lumbricillus*) so closely resemble each other that they need very careful study for their differentiation.

4. **MARIONINA RIPARIA**, Bret.—This small annelid, first described by Bretscher in 1899, has been found by me hitherto but once only. I collected three examples in a little Derbyshire stream near Hartshorne at the end of 1911, and find they agree in all important details with the original description. Length, 4–6 mm. Segments 28 as a rule. Brain deeply incised behind, and slightly concave in front. Setæ usually 3, sometimes 4, in each bundle in the anterior segments, and equal in length; 2 or 3 behind, long; none on the 12th or girdle segment. The intestine, as is frequent in *Marionina*, widens behind the girdle, and gives rise to the dorsal vessel. The coelomic corpuscles are very large and striking, and the nephridia have a large postseptal. The ampullæ were not clearly defined, though Bretscher gives them as three to four times longer than broad. I found a very long, coiled, slender duct attached thereto, but the presence of large numbers of ova obscured the organs here. There is a large heart in front of the girdle, and on segments 11 and 13, preceding and following the girdle, two setæ in each bundle. The vascular system shows the typical arrangement. Found also at Netherseal, Dec. 9th, 1911.

5. **ENCHYTRÆUS HYALINUS**, Eisen.—It will take a long time to disentangle the different species of *Enchytræus*, and I am

now endeavouring as far as possible to go back to the original records and compare the same with living material. Recently I have found annelids at Hastings in Sussex, Gilsland in Cumberland, and elsewhere, which can for the present best be referred to *E. hyalinus*. In some respects Eisen's account might be taken to apply to *E. albidus*, Henle, and *E. pellucidus*, Friend. But there is every reason to think these are all distinct. *E. pellucidus*, Friend, is the form found in rich soil and fat manure. It is quite distinct from *E. albidus*, Henle, if the worm which I found at Hastings belongs to that species. I have found *E. hyalinus*, Eisen, in the same locality, and the two are distinct. The specimens taken at Gilsland, however, differ from the sea-coast forms, and I have determined to distinguish the latter by calling it *E. hyalinus* var. *densus*, Friend. It may be described as follows :—

A white worm, 12–15 mm. in length, with about 45 segments. It is opaque, even dense. The salivary glands are somewhat large and unbranched, like those of *E. pellucidus*, Fr. There are four pairs of nephridia in front of the girdle. The body is full of oil-cells. Chloragogen cells begin in segment 5. The brain is oval, about one and a half times longer than broad. The setæ, which are of about equal lengths, number 3–4 in front, and nearly always 3 (rarely 2 or 4) behind. The spermathecae have an ampulla which is the same length as the duct, but about one and a half times as wide, attached to the œsophagus. The funnel of the sperm-duct is about two to three times longer than broad.

The worm, as is usually the case in this family, is subject to much variation. One specimen examined was 16–20 mm. in length, and had 50 segments, which were annulated. There were large pores on segment 12, and the creature flung itself violently about when irritated. In another I saw the dorsal vessel arise in $\frac{1}{2}$, and in this case the brain was slightly notched or concave behind. The postseptal portion of the nephridia in the hind segments had no distinct duct.

6. *PACHYDRILUS LINEATUS*, O. F. M.—This worm, as already stated, is distinct from *Sænuris* (*Tubifex*) *lineata*, Grube. I have had the good fortune to find it in England, and have been able to compare and contrast the two. Michaelsen ('Das

Tierreich,' x. 80) gives the description and synonymy, but includes therein the synonymy of *Tubifex*. Any helminthologist who had the two living worms side by side would instantly see that one was a Tubificid and the other an Enchytræid. *P. lineatus*, O. F. M., is widely distributed on the Continent. It is found in Denmark, Germany, and Switzerland, and is probably to be regarded alike as an estuarine and a freshwater form. Bretscher found it in fresh water in Switzerland, as I have done in Derbyshire, whereas *Sænuris lineata*, Grube, is at present only known as estuarine. Now that the two have been disentangled it will be easy to follow up their distribution.

7. ENCHYTRÆUS ALBIDUS, Henle, is a very perplexing worm. This is due to the fact that different species have been confused under the common term. Dr. Stephenson has recently contributed some useful notes on Scottish specimens which he attributes to this species. I found specimens at Hastings, Dec. 21st, 1911, which I think must also be placed here. The length is 15 mm. or more when stretched, with about 65 segments. A fairly stout, somewhat opaque, yellowish-grey worm, with tail smaller than is usual in proportion to the diameter of the middle portion of the body. The brain is fairly large, somewhat convex behind, and extends into the 2nd segment. There are usually 4 setæ in front (rarely 3), and 3 in the middle and hindmost portions of the body. Girdle with small glands, large pores, long ducts, no ventral setæ, ampulla slender, about three times as long as broad. The spermathecae are rather short, stout ducts, without glands or diverticula. The nerve chord is enlarged in segments 2-3, and the dorsal vessel in one specimen seemed to arise in segment 15. Here, again, variations occur. One specimen was 20-24 mm. in length, with 70 segments. The salivaries resemble those of *E. pellucidus*, Friend. The postseptal of the nephridia is large, as are also the nephridiopores.

During a visit to the North of England in February last I had the good fortune to find many very interesting annelids at Middlesborough and Gilsland. Some of these are evidently new to science, and I am able here to give details of two of the species.

8. MARIONINA SIALONA, n. sp.—This is the first species which I have as yet found possessing salivary glands. I therefore call it *sialona*, from the Greek term for saliva. The following is the

description :—Length, 10–12 mm., transparent, almost white to the naked eye. Brain not incised behind as is frequently the case, but rounded, one and a half times longer than broad. Long, unbranched salivary glands, resembling those of *Enchytræus pellucidus*, Friend. Setæ 2–4 in front, hooked within. Cœlomic corpuscles large, oval, nucleated, clear or light brown. Nephridia brown ; large postseptal, with duct short, and apparently rising near the posterior extremity. Dorsal vessel rises in $\frac{1}{4}$, where the intestine enlarges, pulsing. Chloragogen-cells warm brown. Funnel of sperm-duct narrow, somewhat long, and usually curved round, so that the length cannot be accurately judged ; estimated at four times longer than broad. Duct of the spermatheca about as long as the ampulla, which is pear-shaped.

This species seems to be a link with *Enchytræus*. The salivaries, setæ, spermathecæ, rounded brain, and almost or quite colourless blood are all *Enchytræus*-like, yet the whole worm is decidedly *Marionina*-like. These discoveries show the difficulties of the systematist in drawing the line between the different genera. Along with the foregoing I found another and a smaller species, which agrees with none of the descriptions which I have been able to consult. I therefore proceed to its description.

9. *MARIONINA GLANDIFERA*, n. sp.—Length about 8 mm., with 36 segments. Of a pinkish white colour. Setæ usually 5 in front (rarely 4 or 6), about equal in length ; from 3 to 5 behind. A small delicate worm, but very active, in which it differs much from the last, though found in the same habitat. Spermatheca long, oval or elliptical sacs, without distinction of duct and ampulla ; attached to œsophagus, and in February full of spermatozoa. The spermathecæ often assume an *r*-shape when at rest. The body is glandular all over, the clear glands being in transverse rows, often as many as fifteen in number behind the girdle in each segment. Cœlomic corpuscles large, brown, numerous, somewhat oval discs. Glands of girdle fairly large, with correspondingly large open spaces. Here also we find large pores and glands, a duct which extends back as far as segment 16, with ampulla about two or three times longer than broad. There are a few chloragogen-cells in 5, the full number in 6, 7, 8, then few or none until the girdle segment is passed. There are usually three setæ in the dorsal bundles of the girdle. Three

pairs of septal glands normally placed; dorsal vessel arising in a kind of heart at $\frac{1}{4}$. The brain incised behind and apparently straight in front, narrowing somewhat towards the anterior portion. Girdle covers $\frac{1}{2}$ xi- $\frac{1}{2}$ xiii, sharply defined. The vascular system is of the simple type. The special features are the glandiferous epiderm, the very long duct, the dark brown cœlomic corpuscles, and the spermathecae. Adult in February.

During a brief visit to the South of England in December last I found several species of *Enchytræidae* new to science. I may here mention the Henleas, the description of which will in due course appear elsewhere.

10. *HENLEA MARINA*, Friend.—No œsophageal glands. Spermathecae with glands.

11. *HENLEA CURIOSA*, Friend.—No œsophageal glands. Setæ, as in the last, not exceeding 4 per bundle. Spermathecae without glands.

12. *HENLEA ARENICOLA*, Friend.—No œsophageal glands. Setæ 3-6 per bundle. Length about 15 mm.

13. *HENLEA HETEROTROPA*, Friend.—One pair of œsophageal glands in segment 7. Setæ 3-6. Length, 12-15 mm.

14. *HENLEA TRILOBA*, Friend.—Œsophageal glands in segment 8. Setæ not exceeding 4 per bundle.

Addendum.—Aided by a Government grant, I have been able, since these notes were sent to press, to still further extend our knowledge of this group of animals. The true *Haplotaxis gordioides* has been found at Hastings. It is quite distinct from *H. curvisetosa*, Friend. The Enchytræids have proved to be very numerous. *Henlea variata*, Fr., and *H. attenuata*, Fr., have been found in Notts, with *Fridericia diachæta*, Bret., *F. glandifera*, Fr., and *F. reversa*, Fr. *Fridericia maculata*, Issel, *F. clara*, Fr., and *F. valdensis*, Issel, are now to be recorded for Derbyshire, while a number of other species or well-marked varieties have been found in these and other places.

NOTES AND QUERIES.

MAMMALIA.

The Noctule (Pipistrellus noctula).—‘East Anglian Daily Times,’ May 8th, 1912:—“On Monday, May 6th (time, 7.30 p.m.), counted ninety-one large Bats flying out of the end of cottage on this estate. I think this must be record. — ALFRED TAYLOR (Ixworth Abbey Estate Yard).”

“Your correspondent, Mr. Alfred Taylor, asks if ninety-one large Bats seen flying out of a cottage is not a record? There is a colony of large Bats (Noctules) here, and I went this evening to count them as they came out. I was rather late, but I counted 125. One evening last summer I counted 196, and many times numbers between 170 and 190. Bell, in his ‘British Quadrupeds,’ says the Rev. Dr. Buckhouse saw 185 taken in one night from the eaves of Queens’ College, Cambridge, but it was a question if they were all one species. —R. H. EVE (Maldon, May 9th, 1912).”

The above instances of unusually large assemblages of this species at their diurnal retreats, the one in East Essex, and the other in North-west Mid-Suffolk, may be worth recording. In both counties the Noctule is fairly abundant, especially in the river valleys. On April 18th two of these Bats were flying, and to all appearance hawking for insects, over the River Alde, near Langham Bridge, at between 11 and 12 a.m., in brilliant sunshine. Again, on the 20th of that month, I noticed one at the same place and at about the same hour, the sky being cloudless and the sun particularly bright and glaring. Possibly some insect for which these Bats have a special liking may have been on the wing just at that time, affording sufficient attraction to tempt these animals out by day. It is no uncommon occurrence for the Pipistrelle to come abroad in the daytime in pursuit of gnats, especially in the winter, instances of which appear year by year in country newspapers. It seems wonderful that the eyesight of Bats should be so adjusted as to enable these animals to catch their prey on the wing, both in the dim twilight and in the full glare of the sun at midday.—G. T. ROPE (Blaxhall, Suffolk).

A V E S.

Nesting of the Grey Wagtail (*Motacilla melanope*) in West Sussex.—It is a welcome task to record the nesting of the Grey Wagtail in West Sussex, another high compliment on the part of the bird to the locality chosen for such distinction. Searching in the records of 'The Zoologist' from the present time back to the dark ages of natural history which its pages illumined, few instances of such an interesting occurrence in the southern counties of England seem to be chronicled. That good observer, W. Jeffery, Jun., of Ratham, near Chichester, mentions having seen a nest of the Grey Wagtail containing young near Petworth in June, 1867. It was my good fortune to find a nest with three eggs on April 30th, and on May 3rd the hen bird was sitting, and was not disturbed. For obvious reasons the site of the nest may be vaguely described as *near Midhurst*. The eggs were very faintly marked with washed-out greyish spots on a dirty-white ground, there being no trace of hair markings. The position chosen for the nest was a ledge between ten and twelve feet above the water, the materials used being dry grass, fibres, and rootlets on the outside, well-lined with black horsehair.—H. MARMADUKE LANGDALE (Compton House, Compton, Petersfield).

Food of the Tawny Owl (*Syrnium aluco*).—For the sixth year in succession Tawny Owls have occupied the same place in our church-tower, and probably owe their lives to the owner of the adjoining estate, who, in addition to being churchwarden, is a strict "owl-warden." This year three eggs were laid and all safely hatched. The following is a list of the food I have found in the nest:—April 15th, two Field-mice, one House-mouse, one Mole, one young Thrush; April 19th, one Field-mouse, one House-mouse, one young Rat, one Mole, one cock Blackbird; April 23rd, one half-grown Rat, one adult Thrush; April 25th, one Mole, one adult Mistle-Thrush, one young Thrush; April 26th, one Shrew, one small Rabbit, one young Blackbird; April 27th, two small Rabbits; April 29th, one Field-mouse, one Rat; May 1st, one small Rabbit, one young Blackbird; May 3rd, two small Rabbits; May 4th, 7th, 10th, 11th, 15th, 16th, nothing. It would seem that, as the owlets get bigger and stronger, they clear off all food brought to them without any assistance from the parents. One of the young birds left the nest some days before the others, and I have noticed the same thing with another brood of four in a nest-box here.—JULIAN G. TUCK (Tostock Rectory, Bury St. Edmunds, Suffolk).

Flight of the Common Snipe.—Although I have seldom had opportunities of studying the Common Snipe, yet I have observed on more than one occasion the flight referred to by Mr. Stubbs (*ante*, p. 196). Peculiar it undoubtedly is, and differs from the corresponding behaviour of the Raven or Buzzard in that a horizontal direction is maintained.—H. ELIOT HOWARD (Clareland, Stourport, Worcestershire).

Flight of the Common Snipe.—Observing Mr. F. J. Stubbs's notes upon the above subject, I take the opportunity of adding some remarks and a copy in part of a MS. at present in my hands, and by permission of the writer, Mr. P. Anderson, one whose personal intimacy with the habits of the Common Snipe I believe to be unrivalled by any other observer in Britain, and that round the whole circle of the seasons during the past (over) twenty-five years in Tiree (he went to Tiree in the summer of 1886), and in many other parts of Scotland previously. Before doing so, let me say that I also have remarked the "plunging" flight of the Snipe many, many times, accompanied by the well-known "drumming"; and on more than one occasion I have witnessed the same "plunging" flight without the least accompaniment of sound, shortly afterwards followed by the twisting, erratic flight horizontal with the ground and close to it, and then its alighting. *But I never had the opportunity of witnessing this phase of flight as described by Mr. Stubbs—belly upwards.* I by no means cast any doubt upon the correctness of Mr. Stubbs's observation; I only regret that a similar opportunity has not been afforded me of clearly seeing the same. Indeed, from my experience and observation of those curious and erratic phases of flights and other habits of *this species* and of others during the spring and summer, or courting and nesting seasons, I am *not* surprised at the erratic movements described by Mr. Stubbs. The *backward plunge downwards* I have also, I feel very sure, seen, but though I recall it, I do not find that I have *noted it down*, perhaps at the time distrusting my own correctness of vision on one or two isolated occasions. Truly, as Mr. Stubbs remarks, it is *well* to walk warily in all such observations. Perhaps the following notes may throw some light upon the subject, quite apart from what has previously been recorded from the early writings of Herr Meves, of Stockholm, and the illustration of the experiments of Dr. Bahr, as well as of others who have written on the well-known subject of the sound of the "bleating" of the Snipe.

Beginning with other matter regarding the bird in his general paper upon the "Birds of Tiree," Mr. Peter Anderson has the follow-

ing passage:—"The Snipe, called 'Gobhar Adhair'—in Gaelic literally, 'Air-Goat,' from the similarity of its 'drumming' to the bleating of a goat. The birds from early spring to August (in fact, there was a Snipe drumming over my garden yesterday evening, March 26th, 1912) continue to utter a drumming sound at intervals. This sound, *which is emitted from the nostrils* [the italics are mine, J. A. H.-B.], can be heard nearly a mile away on a calm evening, or down wind on a light breeze. Immediately before drumming the bird seems to fill the lungs with air by blowing out the chest, and by closely observing it one can see the bird's throat working. When drumming, the wings, tail, and whole body is vibrating. When descending to alight the bird has another note, which sounds like 'kep-ik, kep-ik,' uttered sharply, and when suddenly startled its note is 'scape, scape,' in a squeaky voice. It has still another note when feeding its young along a ditch—a note like 'nem, nem,' or 'mem, mem,' uttered hard and low." Mr. Anderson goes on to say that he is aware that there is a controversy as to whether the drumming sound is produced by the actions of the wing and tail-feathers; "but," he adds, "as everyone is entitled to his own opinion, the above is *mine*, based on a life-long experience and close observation. Such controversy I will leave," he concludes, "to more learned and scientific men."

I have had the above MS. in my possession—as will be gathered from the date of March 26th, 1912—since the latest observation was made by Mr. Anderson. I wrote asking for further information, and I received a letter in reply, dated April 19th. After a few general statements as to his lifelong experience as a gamekeeper in Central Scotland and the Highlands before going to Tiree in 1886, he proceeds:—"On nearly all these estates scattered pairs of Snipe bred, even on Glenartney, which is very high ground; a good many breed there in the 'spritty' hollows . . . Of course, there are far more Snipe breeding in Tiree than in any other place I know." Then comes an interesting passage:—"Some people imagine that Snipe only drum when flying high in air, but *this is a mistake*. They often *begin drumming when rising off the ground* [these and other italics are mine, J. A. H.-B.], and *continue while they ascend* as long as their 'wind' lasts, when they take in a fresh supply and *go at it again*, and so on. It is not at all uncommon for a Snipe to get up within two or three yards of one *drumming as it rises*. If any ornithologist happened to be within three or four yards of a Snipe drumming when rising he would discard the feather theory for ever. The sound is very hard, as if coming from a bone instrument."

I will not add much of my own notes to the above, except to say this: I would hesitate to discard the "feather theory," even if I did witness the Snipe rising and hear it drumming simultaneously, and for one reason, *e.g.* that it has been *proved by experiment, with the tail detached from the body*, as by Drs. Meves and Bahr; and for another reason—or, so far, *belief*—that the same inhalation of air and inflation by the bird till the lungs are filled, and the air-cells which communicate with the lungs are fully distended, causes these curious vibratory sounds by the action of *escaping of the air, whether from the throat and bill or from the nostrils, or upon its contact with the outer air, and its influence upon the peculiarly formed outer tail-feathers*, as has been illustrated by Dr. Bahr. But I have no desire at my time of life to get beyond my depth, so will leave the actual *proof* to "more learned and scientific men," along with Mr. P. Anderson. And perhaps I may be pardoned if I suggest that that proof may be within the grasp, before long, of an experienced anatomist and a thoughtful physiologist, who, should he see this passage, will remember witnessing Dr. Bahr's exposition of the "tail theory," and also consider other facts and observations related above.*—J. A. HARVIE-BROWN (Dunipace, Larbert, Stirlingshire, N.B.).

Flight of the Common Snipe.—With regard to Mr. F. J. Stubbs's communication concerning the Snipe's extraordinary trick of gliding upside down through the air (*ante*, p. 196), I may say that my brother and I have on several occasions seen Snipe behaving in a similar way. The locality was in the Wey Valley, a little above Godalming, in Surrey, and the time was April, in ~~n~~re than one year. Our birds did not behave in the identical manner described by Mr. Stubbs. What we saw was this: when performing the trick the bird flew in switchbacks, just as it does when drumming, but with this difference—on the down stroke of each switchback (where drumming would of course normally take place) it threw itself right over on to its back, just as described by Mr. Stubbs. In this position it reached the bottom of its curve, righted itself, and flew up once more, repeating the process a number of times. If I can lay hands on my notes, I may be able to supply some more details regarding the position of

* A still further interest may evolve, should these facts be placed beyond doubt, which is closely connected with the *ancient past* of the species, but it would be premature—on my part, at least—to say more now. Let us walk warily lest there be a stumble and fall! I think "The Heavenly Snipe" might prove a more expressive name for the *Gallinago gallinago gallinago* (L.). In this, at present, I incline to follow Fenzell, Yarrell, and Saunders.

tail, wings, &c.; but the facts that I have described are vividly impressed on my memory, and certainly bear out Mr. Stubbs's contention that there are many remarkable things to learn about the Snipe! On one point I should, however, like to join issue with him. The fact that the tail-feathers were seen spread in the familiar way at a time when no sound was being produced does *not* necessarily prove that the feathers have nothing to do with the drumming sound. What it proves is merely that the spreading of the feathers alone is not the cause of the sound. It may well be that they must first be spread, and then all or a single pair turned in a particular way so as to catch the wind. This, on the evidence he brings forward, is still a logical possibility. Something of the sort must occur in the Peewit, which can produce the buzzing sound with its wings at will, apparently by altering the angle at which the feathers strike the air.—J. S. HUXLEY (Balliol College, Oxford).

Eider Duck breeding in France.—It may interest English ornithologists to learn that the Eider Duck (*Somateria mollissima*) has nested (and probably continues to do so) on a certain island off the coast of Southern Brittany. This fact was recorded by Dr. L. Bureau as long ago as 1906, but the notice appeared in a somewhat obscure 'Bulletin,' and has, I believe, been generally overlooked. The author was unwise enough to publish the name of the island, with the inevitable result that the nest was interfered with in 1907 and 1908, and possibly since. Apparently the island was never tenanted by more than a single pair. For many summers Dr. Bureau had observed Eider Ducks in the vicinity of the island, so that the ultimate discovery of a clutch of five eggs came as no surprise to him. The incubating female was caught on the nest (by hand), so that there can be no question as to the identity of the bird. I have examined the eggs, which are typical in every respect. This discovery is of great interest, as it is, I believe, a considerable extension of its breeding range as at present known.—COLLINGWOOD INGRAM (Sussex Mansions, Westgate-on-Sea).

Common Gull (*Larus canus*) numerous in Bedfordshire.—By far the largest immigration of any species of Gull into Bedfordshire of which I have record took place during the spell of severe weather in February last. At the Sewerage Farm at Newnham they were to be seen in several hundreds, as well as more or less commonly in other localities along the River Ouse. They were said to be most plentiful on Feb. 5th, but many had been seen previously, and others remained until Feb. 10th. Many were shot and taken to the local taxidermists,

three of which I saw in the flesh on Feb. 3rd. It would be of interest to know if this immigration was observed in any other inland counties.—J. STEELE ELLIOTT (Dowles Manor, Shropshire).

The Ringed or Bridled Variety of the Common Guillemot.—While watching the breeding Guillemots on our (Dorset) coast a few days ago I discovered amongst a small colony of ten one of the ringed or bridled variety on its egg. It was quite by accident I found it, but my interest was aroused when I noticed the conspicuous white rings round the eyes and the white streak running backwards from the eye. I recently read an article by Mr. Geo. A. Emery, of Newcastle-on-Tyne, about his discovery of the breeding of this species (?) in Shetland, and, judging from the title, "A New British Breeding Bird," I should imagine it has not been discovered breeding elsewhere in the British Islands. Now, I think it will be agreed that no error in identification could have occurred, because viewing the bird from about twenty-five yards with a powerful pair of Ross's prism binoculars would be as good as having the bird in one's hand. A man descended with the aid of ropes and brought me up the egg, upon which the bird remained until he was within a very few feet of it. The egg is of a greenish white ground, with spots and splashes (chiefly at the large end) of brown, with greyish underlying marks. The shell feels particularly rough to the touch, and there appear to be a number of raised spots scattered over the surface. This bird does not appear to be generally accepted as worthy of specific rank, and I shall be pleased to hear anything respecting its breeding. However, if the white rings and marks serve to distinguish it, as I imagine they must, there can be no doubt that I have discovered it breeding here, and that the egg in my possession belongs to that bird. I hope to visit the spot again in a week or so, and to forward any further information that may be of interest.—W. J. ASHFORD (Market Place, Blandford, Dorset).

Slavonian Grebe in Bedfordshire.—A Slavonian Grebe (*Podiceps auritus*) was reported to me by Mr. H. Hawkins as having been picked up alive but slightly injured on Feb. 6th, at Newnham, by one of the men on the Sewerage Farm. After being purchased by my informant it was released, but what was evidently the same bird was shot on the River Ouse at Cardington (the adjoining parish) a few days later. Upwards of a dozen previous occurrences of this species in this county are on record.—J. STEELE ELLIOTT (The Manor House, Dowles, Salop).

AMPHIBIA.

Destruction of Toads in the Breeding Season.—For many years past I have been at a loss to account for the great destruction of Toads that takes place during their spawning period, and I should be glad to hear if it has yet been satisfactorily proved what preys so freely upon them, and to what extent such occurs in other localities. Throughout practically the whole course of the River Ivel, in Bedfordshire, Toads spawn in considerable numbers, and during the present year I made several visits to this locality for further investigation. Altogether I must have examined the remains of many hundreds of Toads, and in every instance the victim had been taken some few feet away from the water's edge, invariably eviscerated, and the softer fleshy portions and spawn devoured, and frequently some of the larger bones bared of their flesh. The skin, with head and feet attached, was always discarded. Such remains were usually singly, but two or more together were not infrequent. The prey having been taken on to the grassy bank of the stream, tracking was very difficult, and in only one instance could I find any excrement that might have been left by the depredator. I found similar remains of the Frog, but in a few instances only. My friend Mr. C. Oldham informs me that he has seen similar remains of Toads about the sides of the marlpits in Cheshire, and in one instance those of the Great Crested Newt.—**J. STEELE ELLIOTT** (Dowles Manor, Shropshire).

Batrachians.—Can any reader of 'The Zoologist' assist by original suggestion, or kindly refer me to any published account of the reason for Frogs and Toads making merry, and vocally proclaiming their whereabouts, *after* and not before or during the period of sexual activity? Also, do both sexes croak, and, if one only, which?—**M. C. H. BIRD** (Brunstead Rectory, Stalham, Norwich).

NOTICES OF NEW BOOKS.

Aristotle's Researches in Natural Science. By THOMAS EAST LONES, M.A., LL.D., B.Sc. West, Newman & Co.

THE name of Aristotle is a household word to men of letters ; it is also one frequently referred to by philosophical naturalists, but to few indeed are his scientific conclusions really known, and to still fewer are his writings really familiar. Dr. Lones, in this volume, has earned the gratitude of most scientific men by giving a digest of Aristotle's teachings in distinctive subject chapters, and with full footnote references, so that both verification, and, if necessary, amplification, are obtainable. Although many subjects are beyond the purview of this Journal, such chapters as are devoted to " Distinction between Animals, Plants, and Inanimate Matter," and their " Constituents," " Animal Motion," " Generation and Development," and the " Classification of Animals " are of the highest interest to zoologists, and their perusal will show that many of the pre-notions of Aristotle have proved in a sense almost prophetic. Two terms of classification employed by Aristotle, viz. *genos* and *eidos*, are often translated as *genus* and *species*, and, although the latter is fairly representative, *genos*, as Dr. Lones points out, " usually signifies a class, an order, or a family," and, as an opinion of Agassiz is quoted, " Aristotle already considers fecundity as a specific character." Again, his two divisions *Enaima* and *Anaima* correspond with the terms *Vertebrata* and *Invertebrata* used by Lamarck and Cuvier.

Aristotle was an embryonic evolutionist. He is quoted as saying, " the young animal is not at once a horse or a man, but that its life is at first like that of a plant, and that the characteristics of each kind of animal are the last to be developed." As Dr. Lones well observes : " This seems to foreshadow the modern theory that the history of the development

of the individual is an epitome of the history of the evolution of the species." But these evolutionary conceptions of the most illustrious disciple of Plato did not prevent him receiving a very considerable imprimatur of the Church; and, as remarked in this volume, "the adoption of Aristotle's methods of reasoning was followed by the adoption, in part at least, of his system of philosophy, and the resulting alliance, if it may be so called, between the Church and Aristotelianism became so close that an attack on one was considered to be an attack on the other."

A Catalogue of the Vertebrate Fauna of Dumfriesshire. By HUGH S. GLADSTONE, M.A., F.R.S.E., &c. J. Maxwell and Son.

DUMFRIESSHIRE will always be remembered by British naturalists as the land of Robert Service, and Mr. Gladstone is now recognized as its vertebrate historian—excluding *Homo*.

In the Introduction we read:—"The Solway Firth is remarkable for the rapid rise and surging flow of the tides, now filling up the whole basin with a flood of turbid water, and then ebbing slowly back, till only a mere thread of water is left running down the Firth. The prevailing shallowness, combined with the swiftness of the tides, makes the Firth at times a trap for Cetaceans; and in their northern migration uncommon fish, usually confined to deeper waters or more southern latitudes, occasionally enter the narrow Firth and become victims to its intricate channels and ever-present nets."

The Mammals and Birds are fully recorded, the latter having been previously described by Mr. Gladstone in 'The Birds of Dumfriesshire.' In the enumeration of the Marine and Fresh-water Fish, we notice an entry of a Pike: "Hightae Loch, April, 1830, forty-five pounds; and another at Castle Loch, June 10th, 1835, forty-three pounds." Any authentic instance of a Pike of over forty pounds being taken at present times is a very desirable record.

EDITORIAL GLEANINGS.

THE game prospects of the East Africa Protectorate are dealt with in the 'Empire Review,' and the following digest of the same is taken from the 'Pall Mall Gazette' (April 29th, 1912) :—

"The number of sportsmen's licences last year were 124, compared with 117 in the previous year; residents' licences were 191, compared with 140. The increase of revenue from this source was nearly £2000.

"There are two game-reserves, one lying to the south of the Uganda Railway, between Tsavo and Nairobi, and extending to the Southern Uaso Nyoro and the Anglo-German boundary; the other including the country to the north of the Northern Uaso Nyoro.

"The stock of game in the Southern Reserve is very satisfactory, and there has been little or no disease this year.

"An attempt will be made to acclimatise the wild water-melon of the Kalahar Desert in this area. It is regarded as excellent food for game and cattle, and, if grown successfully, will do away with much of the trouble experienced in obtaining food and water for the Masai cattle and the game during the droughts.

"A certain number of dams will also be made in suitable places in the Reserve. There is a splendid stock of Ostriches in the Reserve at present, and if the Hyenas, which are very numerous, are killed off with poison, the Ostriches should increase rapidly, and stock the surrounding country, to the great advantage of Ostrich farmers.

"The Athi Plains district is mainly visited by sportsmen for Lion-hunting. In spite of this, and the fact that the local settlers kill every Lion they can, these animals appear to be as numerous as ever, and more troublesome. With the exception of Wildebeest and Rhinoceros, the usual game of the plains is still abundant in the district.

"On the whole, the game prospects are most satisfactory. There has been much less disease, and the rains which fell early in 1911 will produce abundance of food and lead to a rapid increase in stock. Eland and Buffalo are showing in larger numbers all over the country, and Wildebeest are also becoming more numerous. Ostriches have increased considerably in the southern parts of the Protectorate. The Rhinoceros is decreasing fast, as is inevitable with so slow a breeder.

"Regarding Elephants, the herds of cows and young appear to

be holding their own, but the larger bulls are getting scarce, and Elephants with heavy tusks are now rather difficult to find.

"The following is a return of game killed in the Protectorate on all licences during the year:—

"Elephant, 46; Rhinoceros, 227; Hippopotamus, 55; Buffalo, 141; Eland, 84; Zebra (Grevy's), 67; Zebra (Common), 646; Oryx (Callotis), 12; Oryx (Beisa), 236; Water Buck, 310; Giraffe, 17; Sable Antelope, 7; Roan Antelope, 29; Greater Kudu, 1; Lesser Kudu, 49; Topi, 159; Coke's Hartebeest, 643; Neumann's Hartebeest, 24; Jackson's Hartebeest, 227; Thomas' Kob, 27; Bongo, 5; Palla, 419; Wildebeest, 183; Grant's Gazelle, 445; Waller's Gazelle, 57; Duiker, 108; Dik Dik, 162; Oribi, 191; Suni, 1; Klipspringer, 59; Ward's Reedbuck, 247; Chamber's Reedbuck, 44; Thompson's Gazelle, 618; Peter's Gazelle, 69; Bushbuck, 178; Colobi Monkeys, 271; Marabout, 124; Egret, 13; Steinbuck, 5; Paa, 2."

"THE large New Zealand Snail (*Paryphanta*) is an interesting native mollusc. It is, probably, one of the most handsome Snails in the world. In some parts of New Zealand it is fairly plentiful, but in other parts it is rare, and to the average New Zealander it is unknown, or, at any rate, is not nearly as well known as the hosts of introduced Snails that inhabit gardens and cultivated fields. Some of the species perpetuate the names of men who have taken some part in the history of the country. The first species discovered was *Paryphanta busbyi*, named in honour of Mr. James Busby, the first Resident Agent of the British Government in New Zealand. The next species discovered was given the specific name of *hochstetteri*, after Dr. Von Hochstetter, who visited New Zealand in the Austrian frigate 'Novara' in 1858. The vessel was fitted out under the orders of the Archduke Ferdinand Maximilian for a voyage round the world, and Hochstetter was appointed geologist to the expedition. He found the first specimen of the species that bears his name near some ponds on the Dun Mountain Pass, between Nelson and the Pelorus Valley. Other shells of *Paryphanta* have been found in the north of Auckland district, Collingwood, Stephen Island, in Cook Strait, Manawatu, Picton and on Mount Rochfort, near Westport. This Snail lays a comparatively large calcareous egg. It is exclusively carnivorous in its diet, and lives mainly on earthworms and small snails. Its favourite method of preying on other molluscs is to bore a hole in the shell, insert its long, pointed tongue, and draw out the occupant. The anatomy of *Paryphanta* has been dealt with very elaborately by Beutler, a German scientist, and, less compreh-

hensively, by Mr. Murdoch, of Wanganui."—(J. DRUMMOND, F.L.S., &c., 'Lyttelton Times,' March 2nd, 1912.)

"THE record of fish (freshwater) caught last season has been compiled by Mr. A. R. Matthews, and from this list, which appeared in last week's 'Angler's News,' we note that the best Salmon last season weighed 45 lb. and was caught in the Wye, though five Salmon over 40 lb. were caught on the Shannon in Ireland. The best Trout weighed 14 lb. 8 oz., and was taken from Lough Corrib. The largest Pike, a fish of 32 lb., was caught on Lough Conn. The best Roach came from Horsey Mere (Yorkshire), and weighed 2 lb. 11½ oz. A fine Bream of 7 lb. 8 oz. was taken at Drayton, in Norfolk. Cheshunt Reservoir yielded the best Carp, 17 lb. 2 oz., and a fine Tench of 6 lb. 2 oz. was caught in Daventry Reservoir. A Perch of 4 lb. 13¼ oz. was had in a pond in Derbyshire, and the Trent yielded the largest Barbel of the season, a fish of 8 lb. 13½ oz. In regard to angling feats, it may be mentioned that Miss Kathleen Olliver, aged only six, caught a Trout of 10 lb. on Lough Corrib, whilst Mr. Greenhill caught a 43 lb. Salmon on a light trout-rod and fine line, only securing the fish after having played it for six hours!"—('Shooting Times,' April 6th, 1912.)

THE above record applies to the freshwater fishes alone. In the 'Angler's News' for May 25th the subject has extended to "Rod-caught Specimen Sea-fish for 1911-12." The largest Bass was taken at Eastbourne by Mr. E. R. Warner, and weighed 12 lb. 8 oz. A 29 lb. Cod was captured at Lowestoft by Mr. Nash. A Conger of 43 lb. was caught at Valencia by Mr. Murmann. The largest Dab recorded was one weighing 2 lb., and secured at Aldeburgh. A Dog-fish (species not mentioned) weighing 62 lb. was taken by Mr. Drew at Herne Bay. Dr. Huxtable, at Hastings, took a Flounder weighing 2 lb. 8½ oz. A Grey Mullet which weighed 5 lb. was caught at Portland by Mr. Fall. The largest Gurnard, weighing 4 lb. 8 oz., was taken by Mr. Travers at Hastings. A Haddock of 7 lb. 8 oz. was secured at Plockton by Mr. Hawkings, and a Hake weighing 17 lb. 8 oz. was captured at Penzance by Mr. Ashby. The largest Halibut in the record was one weighing 91 lb., taken by Mr. Killick at Ballycotton. A Ling weighing 45 lb. fell to the rod of Mr. Nicoll at Penzance, and at the same locality Miss Heane captured a Mackerel weighing 1 lb. 12 oz. At Eastbourne a Pollack weighing 15 lb. was taken by Mr. Wood, and at the same neighbourhood a Pouting of 3 lb. was caught by Mr. Tarrant. The largest Sea Bream

in the list weighed 4 lb. 10 oz., and was secured by Mr. Perry at Penzance. A Skate weighing 166 lb. is placed to the credit of Mr. Falcon at Ballycotton. A "single gut hook" used by Mr. Dalton at Eastbourne proved the destruction of a Turbot weighing 10 lb. 8 oz. An immense Whiting, weighing 5 lb., was caught by Mr. Nicoll at Penzance. The largest Wrasse was one of 4 lb. 4½ oz. taken at Weymouth by Mr. Russell. It must be remembered that the above were rod-caught specimens; in several instances bigger fish have been taken by anglers using hand-lines.

AN Official Guide has been appointed by the Trustees of the British Museum (Natural History) to conduct parties of visitors round the Collections. No charge is made for his services, and no gratuities are to be offered. The Guide starts from the entrance of the Gallery to be visited at 11.30 a.m. and 3 p.m. daily, except on Sundays. Each tour lasts about an hour, and the Museum is divided into sections, which are taken respectively at the times mentioned below:—

	MORNINGS, 11.30 a.m.	AFTERNOONS, 3 p.m.
MONDAY	Upper Mammal Gallery. Botanical Gallery.	Lower Mammal Gallery and Corridors. (Carnivora, Ungulates, &c.)
TUESDAY	Reptile Gallery. Fish Gallery. Starfish Gallery.	Bird Gallery. West Pavilion. (British Vertebrates.)
WEDNESDAY	Whale Gallery. Shell and Insect Gallery. Coral Gallery.	Fossil Mammal Gallery. East Pavilion. (Fossil Birds, &c.)
THURSDAY	Fossil Reptile Gallery. Special Palaeontological and Stratigraphical Collections.	Central Hall. North Hall. (Domesticated Animals, &c.)
FRIDAY	Galleries of Fossil Fishes, Invertebrates, & Plants.	Mineral Gallery. Meteorites.
SATURDAY	General Tour—Zoology.	General Tour—Geology, Minerals, and Botany.

